Remarks of
NASA Administrator
Daniel S. Goldin

National Aviation Club
February 11, 1998

Just about a year ago, I delivered a speech on NASA's Three Pillars and Ten Goals which represented our vision for Aeronautics.

Today, I want to talk a little bit about how we make that vision a reality -- the process and the progress.

But first, I'd like to fuel your imagination. I want you to think about what a business trip of the future might be like . . . let's say a business trip to Tokyo, via Los Angeles.

You're a wonk, so your trip starts on K Street . . . downtown, Washington, DC.

You leave your office and take a short walk -- maybe three minutes -- to a heliport. There a Tiltrotor aircraft picks you up.

It takes off -- straight up like a helicopter -- and flies directly over the terrible traffic. The best part of the Tiltrotor, especially in Washington . . . no potholes.

15 short minutes later you arrive at a Washington airport. Dulles.

You figure you saved at least an hour already.

You proceed to the satellite terminals. Because you will be flying to Los Angeles on your company's personal business jet.

You work for a small company, but most companies have their own jets now because the cost has come down so dramatically. Instead of tens of millions, they only cost a few hundred thousand dollars, maybe less.

They're also much, much safer.

You remember the late 1990s when a general aviation plane had about one-tenth the reliability of a long-haul jet transport. Now, they're just as reliable as the long-haul jet transport of the 90s.

As you approach LAX, you notice some fog. No worries.

With Surface Movement Advisors and T-NASA (Taxi Navigation And Situational Awareness),
LAX has had all-weather operations in place for several years. And synthetic vision allows you to see through even the heaviest of fog and better at night, as well.

It's another advancement that has enabled airports to increase their capacity and safety.

After arriving at LAX, you step outside.

You notice that increased air traffic. Capacity -- or throughput -- has at least tripled since the 1990s.

But you can hardly hear the airplanes. You realize that is because their sound is drowned out by normal traffic.

The planes are quieter and emissions have been reduced, too.

You board another Tiltrotor for your lunch time meeting in downtown Los Angeles. The many traffic alerts -- and the miles of gridlock on the Freeways -- are of no concern.

This time you figure you have saved an hour and a half of driving time . . . three hours of driving time if you count the trip back to LAX.

And if you count the time saved in Washington earlier that day, you figure you have now saved over four hours of driving time.

4 hours.

That's just a little less time than your entire supersonic flight from LA to Tokyo. And that flight to Tokyo doesn't cost any more than a subsonic flight of the 1990s . . .probably less . . . because of the outstanding work of the aeronautics and airline industry that set this up.

In fact, in about the same amount of time it took you to get from your office in Washington to downtown LA . . . you have not only traveled from LA to Tokyo . . . but you're also half way through your big presentation.

And compared to traveling in the 1990s, it was not only faster, but also cheaper, better, cleaner and safer.

All in all -- not a bad way to do business.

That's the vision. That's the way the aeronautics industry will prosper. And that's the way America will lead the world . . . not only in economic terms, but also because the civil aviation program will help build a strong defense.

Today, I'd like to give a quick recap of our goals to achieve that vision. And I'd like to talk about where we are, what we're doing, and what must be done to make sure that this is a trip of the future . . . only for the time being.

But as I do, let the basis for each and every goal be this: NASA wouldn't, couldn't, and shouldn't

do this alone.

We formulated these goals in partnership with America's great aeronautics industry and our FAA and DOD partners. That was the easy part.

Our partners -- academia and industry members . . . including aircraft manufacturers . . . airline operators . . . and suppliers -- must be also involved in the hard part. The research and implementation of this vision.

NASA is focused on the high-risk technologies needed to achieve the stretch goals. But we are also committed to developing the partnerships to transfer our work into aerospace operations and products.

We are in the process of developing national investment strategies for each of the ten goals I will summarize today . . .something we call "Roadmaps."

These ten Roadmaps will guide our future investments, partnerships, and the way we evaluate our progress.

After a very productive series of workshops with broad participation from industry, government, and academia, we have completed three of these Roadmaps --Aviation Safety . . . airspace capacity . . . and reducing travel times across the Pacific Ocean.

This past year we have already held 6 additional workshops and have two more coming up this spring. And we will have the remaining seven Roadmaps complete by this July.

This is significant progress. Consider that these are ten year Roadmaps and twenty year Roadmaps with annual goals of what we want to achieve. And we will give ourselves report cards once a year to make sure we are on track.

Now for the goals.

The first goal is to improve aviation safety.

Goal One -- We want to reduce the aircraft accident rate by a factor of five within ten years, and by a factor of ten within 20 years.

That's measured by the bottom line. It's measured from the planes that come rolling out of the production plants . . . not the technology that NASA already has.

In support of the President's initiative on Aviation Safety and Security, NASA and the FAA
have formed a partnership to accomplish The Aviation Safety Program.

NASA stepped up to this national priority and has committed to reprogram $500M of the aviation enterprise's budget over 5

years.

We didn't whine and cry and go back to the President or Congress and tell them we need more money.

We are demonstrating by our example that we are an agency that believes in deficit reduction. And we want to be an example for America that we are not a federal agency sucking up the future like a vacuum.

That's one of the reasons I'm so proud and excited about the progress I have seen since March.

We worked in a very different way to plan the Aviation Safety program. We included partners and customers from "day one," and together, we defined the initial investment strategy, focusing on the highest pay-off areas for aviation safety.

In fact, today at the National Press Club, there will be a briefing conducted by the Air Transport Association, on the details of Industry's current and future activities for improving aviation safety.

NASA Program Plans for Aviation Safety will be complete late this spring.

Our work is split into three technical solution paths worked out by the joint industry/government safety team: 65 percent is directed towards prevention, 25 percent towards aviation system monitoring and modeling, and 10 percent towards accident mitigation.

In terms of technology, together, we must come up with the technologies for advanced crew interface. We must give pilots situational awareness of their surroundings. That means real-time weather . . . terrain. . . and on board air traffic control.

Pilots must have not just data, but knowledge . . . so they can immediately take the right course of action.

We are also working on creating smart airplanes that can predict, detect, and correct potential malfunctions before they become serious problems.

Already, in 1997 we successfully demonstrated cockpit systems for enhanced situational awareness during landing and aircraft rollout and taxiing at the Atlanta Hartsfield Airport.

These systems aid pilots in viewing the runway and taxiways during night or adverse weather,
improving airport safety and increasing capacity.

There have been some very serious -- sometimes fatal -- accidents on the tarmac . . . not even in the air. That's why this work is so important. And we're making significant

progress.

The next area is environment.

We need to make sure that environmental issues do not constrain air transportation growth.

Aircraft emissions are an issue with local air quality and global impact. And aircraft noise is an issue prompting an ever increasing number of airports, both here and abroad, to restrict airline operations.

Sometimes for competitive advantages . . . but other times for goodness and virtue.

So we've developed the following goals:

Goal Two -- We want to reduce emissions of future aircraft by a factor of three within 10 years, and by a factor of five within 20 years.

And Goal Three -- We want to reduce the perceived noise levels of future aircraft by a factor of two from today's subsonic aircraft within 10 years, and by a factor of four within 20 years.

Last May, we published the first scientific assessment of aviation's global atmospheric impacts.

These results and the continuing scientific research will greatly help the aviation community respond to the Kyoto Protocol for reducing greenhouse gas emissions.

We also made excellent progress in combustion technology with laboratory demonstrations of a 70 percent reduction in nitrogen oxides below current ICAO standards for local air quality.

That's a great step forward.

This is moving well towards our objectives at the ten-year horizon. However, there is still much to be done to prove effective and economic emission control on production-scale hardware.

And as for reducing the noise levels, research advancements in jet noise, fan noise, and nacelle duct treatments show a 4 decibel reduction in community noise impact.

This, too, is tremendous progress.

In airport terms, an airplane's noise "footprint" is reduced almost 33 percent . . . from an 8 square mile baseline to less than 5 and a half square mile area.

The year 2000 goal is to provide technology that could reduce the noise footprint to two and a half square miles, for a 68 percent reduction. Again, this is an example of how we measure progress on our Roadmaps.

Being globally competitive will require non-traditional collaborations and a willingness to trust this strategic outlook. We are looking at the longer term, approaching these areas with some restraint
because we realize the environmental challenges are complex and very sensitive issues.

So let me add that these goals must not be construed as a "done deal," especially for regulatory purposes.

It will be chilling to the program if regulators assume our stretch goals can be used for establishing premature or inappropriate regulations.

NASA is not in the business of encouraging regulatory limits.

NASA is in the business of developing robust technological solutions.

We must understand more about the impact of these technologies -- striking a balance between performance demands and their costs -- because value-added technology cannot come at any cost.

In 1995, the aviation community, including the FAA, DOD, and NASA, recognized the Nation's airspace system operations needed to change to meet the projected growth in demand.

If left unchanged, providing predictable, on-time scheduled service early in the next century could be a major challenge if not a disaster.

The next goal has to do with capacity.

There's a crisis coming because of the demand for aircraft and the current limitations of the infrastructure.

Goal Four: While maintaining safety and reliability, we want to triple the aviation system throughput, in all weather conditions, within 10 years.

We have been working closely with the FAA in several areas to address our aviation system's throughput.

The FAA and NASA strategically manage the transfer of air transportation technology into deployable systems. And we have established an Air Traffic Management R&D Executive Steering Committee to oversee applicability of capacity research technology.

An operational concept for "Free Flight" was developed to allow airspace system users to take advantage of satellite-

based navigation, digital communications, highly accurate surveillance, and decision support tools for air traffic controllers, pilots, and planners.

I might point out, that NASA reprogrammed an extra $400 million into this project. We didn't go back and whine for more money . . . we canceled lower priority projects.

Next -- cost.

The costs of air travel keeps going up . . . from acquisition to operations. But the revenues keep going down, except for the last two years.

Goal Five: Reduce the cost of air travel by 25 percent within 10 years, and by 50 percent within 20 years.

As airlines buy new aircraft to replace old ones, ownership costs have been going up faster than operating costs go down. This is a formula for disaster for the industry.

To lower the cost of travel for the American public, we must lower the cost of aircraft ownership and operation.

This will require significant inroads in reducing the weight, cost, and fuel consumption of aircraft. NASA-Industry teams have a long history of working together in these areas, and are providing significant contributions.

An example is the work being done in advanced stitching technology for composite structures.

This work has demonstrated that a 5-fold increase is possible in the number of composite wings manufactured per month, with an estimated 20 percent reduction in manufacturing costs.

In addition to those savings, composite wings allow more efficient, lighter weight designs that have lower drag, thereby reducing fuel consumption.

It is important to remember that, although each goal is presented as a distinct entity, they are clearly interdependent.

As technologies for one goal are developed, they may contribute towards other goals as well. The stitching technology I just mentioned will not only reduce the cost of air travel, it will also lead to reduced emissions.

Next, the forecast of demand for a new supersonic airliner for the long-haul market has consistently been strong. We need to get this done. Mach 2.4.

And NASA won't back off.

The public, rightfully, would like their time in the air to be a little shorter . . . and their time at their destination to be a little longer. That's fair.

And if the ticket cost can be made affordable, the Pacific Rim and the European markets for this aircraft could support a $200 billion global industry, and 140,000 highly-skilled jobs. Plus, it will lead to further improvements in the American market, the Asian market . . . and markets around the world.

This is a crucial piece goal.

Goal Six: Reduce the travel time to the Far East and Europe by 50 percent within 20 years and do so at today's subsonic ticket prices.

Our High-Speed Research program, built on a strong Industry-NASA partnership, continues to make substantial progress.

We are confident that the engine research to date indicates that we will overcome the emissions barrier.

One of our most recent achievements is the definition of the new Technology Concept Aircraft.

Supersonic wind tunnel tests on the concept aircraft have validated the performance predictions.
We also successfully completed flight tests on an artificial vision system that would eliminate the need for a drooped nose design on future supersonic airliners.

As you know, when the Concord comes in at a high angle, it has to droop its nose so the pilots can see out the window.

On our supersonic transport, there will be synthetic vision which allows pilots the same view as looking out a cockpit window. You won't have to droop the nose or spend the money on that complex design, and it will decrease the chance of a problem.

This is going to be great technology.

Our current plans, which carry us out to the year 2006, have been a fruitful investment. In fact, we just announced on Monday of this week, that we are going to begin construction of a full-scale engineering model for a Mach 2.4 jet engine.

I'm excited about that.

We are confident that this program will continue to provide solutions overcoming the environmental and economic challenges, allowing industry to make product launch decisions on a future High Speed Civil Transport.

On the other end of the spectrum, enabling a whole new mode of personal air transportation also has tremendous social and

economic importance. An estimated 20,000 smaller communities, too small to warrant scheduled commercial air services, will be much better connected to the national system. And economic opportunity will not be limited to the few hundred large cities who have scheduled air transportation service.

This is crucial to the future infrastructure of our nation.

Goal Seven: Invigorate the general aviation industry, delivering 10,000 aircraft annually within 10 years, and 20,000 within 20 years.

These are the minimum goals. We'd like to do more. But this is what I signed my name to.

In the late 70s, we produced almost 20,000 general aviation planes a year. Right now, we produce only 1000 general aviation planes a year.

That's not even close to where we need to be. That's even behind some developing nations.

And although this goal is in terms of aircraft delivery, the underlying result will be to fuel a significant economic expansion beyond general aviation.

For every 10,000 new general aviation aircraft deliveries, $1 billion in sales and $2 billion in additional economic activities are projected.

This will mean about 6,000 direct aviation jobs . . . and 24,000 associated business jobs just in the process of building these planes. Think about when you open up those 20,000 rural communities to good, reliable, safe and frequent travel. America will blossom.

Achieving this goal will also play an important role in the "travel-on-demand" needs of the growing global business world.

In addition, roughly 50 percent of general aviation deliveries are exported annually to areas where extensive ground transportation infrastructure does not exist. Think of the potential markets in places like Russia and China. The demand is staggering.

The next goal may be the most significant because, when achieved, it will dramatically affect the way we design products from aircraft to spacecraft and much more.

Goal Eight: Provide next-generation design tools and experimental aircraft to increase design confidence, and cut the development cycle time for aircraft by a minimum of 50 percent.

Imagine designing a new airplane where the design evolves 24 hours a day.

Manufacturers . . . parts designers and suppliers . . . maintenance organizations . . .
and users, who are distributed in every time zone of the world . . . shape the product with their unique abilities and innovations.

This will allow designers to go beyond designing just for manufacturing, to designing for maintenance and the full life-cycle of the product.

On the X-34, which we are going to fly next year, we are doing maintenance and operations with cyber-gloves and cyber-masks so we can check out the whole process before we cut any hardware.

Imagine, instead of taking the "Red Eye," these teams come and go electronically.

Imagine simulators of the individual machine.

Imagine real time assessment of inventory flow control.

Imagine simulating an entire factory -- with total immersion virtual presence, complete with sight and sound . . . perhaps even feel and smell -- before we build it.

Before you build it, you will be able to determine the harmonics of that factory . . . you will be able to determine whether it will work as planned or not.

This is a crucial, crucial area. We call it Intelligent Synthesis Environment.

Before you have to commit 90 percent of the resources, you will have 70 to 80 percent of design confidence. Today, when you commit 90 percent of the resources . . . you only have 10 percent design confidence.

That's why we have overruns. That's why we have failure. And that's why corporations lose money.

So that's where we are going.

But even with the power of these tools, experimental aircraft will always play a significant role in validating technology.

Over the past 50 years, literally hundreds of joint flight research programs and flight experiments between NASA and DOD -- most notably the X-planes -- have led to significant new capabilities for operational aircraft.

Somehow we lost our way. But we're coming back.

We are building an unpiloted Hyper-X vehicle that will demonstrate hydrogen-fueled, airframe integrated, dual-mode ramjet and scramjet propulsion.

Flight tests at Mach 5, 7, and 10, will prove out technology that will have an immense impact in both aviation and space access.

And by the way, the whole cost of the program, including three test vehicles is only $167 million..

We are committed to recapturing the pioneering spirit of the earlier days of flight testing by renewing our emphasis on X-planes.

The tailless X-36 built by McDonnell-Douglas, now Boeing, just completed flight testing. And the Hyper-X will soon take to the skies at over Mach 7.

Each of these vehicles symbolizes our renewed emphasis on "innovation through flight."

And finally, the last two goals.

We need to examine what vehicle systems are the most efficient and safe for flying cargo and astronauts to and from the new Space Station and to meet our future exploration needs . . . like building research stations on asteroids . . . like going back to the Moon . . . and like having an exploration team on Mars.

Goal Nine: Reduce the payload cost of low-Earth orbit by an order of magnitude,
from $10,000 to $1,000 per pound within 10 years,
while at the same time, improving reliability by a factor of ten; and

Goal Ten: Reduce the payload cost to low-Earth orbit by an additional order of magnitude, from thousands to hundreds of dollars per pound, by the year 2020, and improve reliability by a factor of 10,000 . . . so the potential for failure is one part in one million.

We are making excellent progress on our two main technology demonstration projects, the X-33
and X-34.

The X-34 has successfully completed both preliminary and critical design reviews of the vehicle's main propulsion system. And major portions of the fuselage and wing are under construction at Orbital Science's Dulles facility.

Funding for a second X-34 vehicle has also recently been approved and we anticipate the first flight of X-34 in March of next year.

During this past year, we completed the Critical Design Review of the X-33.

Specifically, we have completed over 70 percent of the

thermal protection system design. We also conducted a successful multi-cell hot-fire test of the linear aerospike engine, and have begun flight testing it on an SR-71.

The X-33 is also on track to meet its July, 1999 launch date.

We're going to build a vehicle that will go to Mach 15. And the first flight is going to be from Edwards Air Force base to an Air Force facility in Utah.

It will be scary. We'll hold our breath. But we're not afraid.

This past year, we completed the Environmental Impact Statement for the X-33 flight tests, during which we found strong and enthusiastic public support for the program.

Keep in mind, we no longer launch over the ocean. We're going right over land. And to have the American public so excited for these Mach 15 vehicles to be flying over their heads warms my heart. It reminds me why this country is so great.

As a result, Malstrom Air Force Base, Montana was selected for the landing site for the X-33 long-range flights, and as I just mentioned, Michael Army Airfield in Utah was selected for the intermediate flights.

For the longer view, we chartered the Space Transportation Council, an internal panel, to establish the requirements for system upgrades and new space transportation systems.

The Council, after soliciting inputs from the space transportation community, has developed a comprehensive space transportation strategy and implementation plan. And they will be responsible for ensuring the plan is implemented as we attempt to make dramatic reductions in the cost of space flight.

And as we make these dramatic reductions, we're going to design a little . . . build a little . . . fly a little . . . crash a little . . . pick ourselves up . . . and keep repeating it until we get it right.

The total picture however, is not complete. As we move forward, we must keep three things in sight:

1) The importance of measuring progress at the national level.

2) The importance of communicating with and receiving feedback from the public, our ultimate customer; and

3) The importance of international cooperation where it makes sense and where it is in our interest

We must be able to track our technical progress toward the goals and communicate this information with the public.

And the public must be able to understand where their tax dollars are going.

Therefore, I am announcing a national conference on "Turning the Goals into Reality," which will be held this coming October in Cleveland, Ohio. And we hope to hold another one every year in October in different parts of the country, so we can openly discuss how we're meeting the goals of our programs with all interested parties.

The details of this conference are still being worked out. But this will be our first opportunity to report to industry and the public at-large on our progress in achieving the Three Pillars and the Ten Goals.

Additionally, since many of these outcome goals have a global impact, we must explore the possibilities of international cooperation where possible and appropriate.

Last year, I made Aviation Safety NASA's number one technology priority in aeronautics. (Shuttle safety is our number one technology priority agency-wide.)

To make a meaningful impact on the safety of the entire aviation system we must think and act globally.

That is why, I believe, we must take Aviation Safety from a national goal to an international goal.

We have already begun discussions with the European community to explore ways to cooperate in our safety research.

And later this month, we are sending a NASA and FAA delegation to Europe to define the technical details of this cooperation.

I hope we can have a future international conference with our European aviation research colleagues and others from around the world, to highlight aviation safety research.

Because safety is everyone's business.

One last word.

The work ahead of us is hard. Sometimes it will be frustrating. It will be costly. We will have -- from time to time -- a failure.

The goals are indeed "stretch" goals.

But . . . they are by no means out of reach.

And if we continue to work together, we can take firm hold of

our future . . . a future filled with hope and opportunity.

And who knows -- on that trip of the future to Tokyo, you may pick up a gift for your grandchild.

And you will be able to send that gift -- affordably and reliably -- to your grandchild's office.

On the moon. Or maybe on the International Space Station.

It's OK to dream. It's OK to set "stretch" goals. It's OK to pursue bold tasks.

It's OK . . . in fact, it's essential.

Our future depends on it.

The Administration has signaled its support of NASA with the President's 1999 budget, so now we must deliver.

We at NASA have rolled up our sleeves, but, again, we can't do it alone.

We are counting on our partnerships with you, in industry, in government, and in academia . . . to work with us to turn these goals into reality.

So let's get to work. And let's get to work together.

Thank you.

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I'd like to begin this morning by describing a trip. A business trip around the world. A business trip of the future . . . at least for the time being.

It starts on K Street . . . downtown, Washington, DC.

After you finish up your morning meetings, you are ready to head off on the first leg of your trip -- Los Angeles, California.

You call the Airport Shuttle Service. 3 min walk

They promptly send their Tiltrotor aircraft to pick you up.

It lands directly in front of your office. Lifts straight up like a helicopter. And takes you straight to the airport.

This is no ordinary taxi cab.

You don't have to worry about how many zones you've traveled. The pilot and crew are courteous. No potholes.

While you're on the Tiltrotor, you pull up the Wall Street Journal on your seat monitor and note that an upgraded longer-range supersonic airliner is now in production. You nod in approval because then your trips to Singapore will be non-stop and take less than seven hours.

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15 minutes later you arrive at a Washington airport . . . Dulles.

You proceed to the satellite terminals.

On this leg, you will be flying on your company's personal business jet.

Most companies have them now . . . because the cost has come down so dramatically . . . perhaps costing only a little more than a luxury automobile. speed

You take-off smoothly. You have a peaceful flight. You arrive in LA rested and ready for your late afternoon meetings. And you have enough energy afterwards to visit your grandchild.

The next morning ~~you have~~ business in Santa Barbara.

From there you will go to LAX and then to Tokyo for a presentation.

Once again, the Tiltrotor picks you up at your door for the 15 minute hop to LAX.

This time you pull up the Los Angeles Times.

There is another article on the airline industry . . . this one celebrating 5 straight years of flying with no fatalities. You can't remember the last time you've read about a major accident, even though air travel has tripled in volume since 1998.

It's a foggy morning. But no worries.

With Surface Movement Advisors and T-NASA (Taxi Navigation And Situational Awareness), LAX has had all-weather operations in place for several years.

When you arrive at LAX, you take note of the heavy air traffic.

But you can hardly hear the airplanes. You realize that's because their sound is drowned out by normal traffic. The planes are quieter . . . and emission have been reduced, too.

Inside the terminal it's very busy, but travelers are moving efficiently in and out of the gates, smiling, and looking relaxed. You look at your watch. There's another 20 minutes before your flight leaves.

You board the plane . . . sit back . . . and in five hours, you're not only in Tokyo . . . you're already ten minutes into your big presentation.

You eat at your favorite restaurant in downtown Tokyo . . . pick up a gift for your grandchild . . . and before you know it, you're back home.

All in all -- not a bad way to do business.

At NASA, we are coming off a great year.

But with all the news from the Mars Pathfinder . . . to the Hubble Telescope . . . to the Space Shuttle . . . sometimes people tend to forget you can't spell NASA . . . without Aeronautics.

And one of the most important things we did last year was to unveil 10 "stretch" goals in aeronautics and space transportation technology.

These goals are helping to define the technology needed to realize the kind of vision I just described in that trip to Tokyo.

These goals are necessary to create an aviation industry that is faster, better, cheaper, cleaner and safer.

And these goals are absolutely crucial if the United States is to sustain leadership in the 21st Century.

Because as we look to the next century, there is no question: air transportation is the only viable means of moving people and cargo quickly around the world.

Today, I would like to quickly go through these important goals . . . and I want to give you a snapshot, from a NASA perspective, of where we are today.

But as I do, let the basis for each and every goal be this: NASA can't, shouldn't and doesn't want to do this alone.

We formulated these goals in partnership with our industry and FAA partners (and they are published in a brochure, "Three Pillars for Success.").

And just as they were deeply involved in developing this vision . . . our partners -- academia and industry members . . . including aircraft manufacturers . . . airline operators . . . and suppliers -- must be involved in the **research and implementation** of this vision.

I am proud to report that I recently met with several industry leaders. They all confirmed their strong support for these goals and NASA's role in achieving them.

The first goal is to improve aviation safety.

We want to reduce the aircraft accident rate by a factor of five within ten years, and by a factor of ten within 20 years.

In support of the President's initiative on Aviation Safety and Security, NASA and the FAA have formed a partnership to accomplish The Aviation Safety Program.

NASA stepped up to this national priority and has committed to reprogram $500M of the Enterprise's budget over 5 years.

This is <u>not</u> new funding, but funding redirected by the Enterprise from its existing work.

I am very excited about the progress I have seen since March. We worked in a very different way to plan the Aviation Safety program. We included partners and customers from "day one," and together we defined the initial investment strategy, focusing on the highest pay-off areas for aviation safety.

The work is split into three technical solution paths worked out by the joint safety team: 65% is directed towards prevention, 25% towards aviation system monitoring and modeling, and 10% towards accident mitigation.

In terms of technology, together, we must come up with the technologies for advanced crew interface. We must give pilots situational awareness of their surroundings. That means real-time weather . . . terrain. . . and on board air traffic control.

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We must understand more about the impact of these technologies, striking a balance between performance demands and their costs, because value-added technology cannot come at any cost.

In 1995, the aviation community, including the FAA, DoD, and NASA, recognized the Nation's airspace system operations needed to change to meet the projected growth in demand. If left unchanged, providing predictable on-time scheduled service by early in the next century could be a major challenge.

The next goal has to do with capacity.

There's a crisis coming because of the demand for aircraft and the current limitations of the infrastructure.

Goal Four: While maintaining safety and reliability, we want to triple the aviation system throughput, in all weather conditions, within 10 years.

We have been working closely with the FAA in several areas to address our aviation system's throughput.

The FAA and NASA strategically manage the transfer of air transportation technology into deployable systems and have established an Air Traffic Management R&D Executive Steering Committee to oversee applicability of capacity research technology.

An operational concept for "Free Flight" was developed to allow airspace system users to take advantage of satellite-based navigation . . . digital communications . . . highly accurate surveillance . . . and decision support tools for air traffic controllers, pilots, and planners.

Next -- cost.

The costs of air travel keeps going up . . . from acquisition to operations.
But the revenues keep going down.

Goal Five: Reduce the cost of air travel by 25% within 10 years, and by 50% within 20 years.

As airlines buy new aircraft to replace old ones, ownership costs have been going up faster than operating costs go down.

To lower the cost of travel for the American public, we must lower the cost of aircraft ownership and operation.

This will require significant inroads in reducing the weight, cost, and fuel consumption of aircraft. NASA-Industry teams have a long history of working together in these areas, and are providing significant contributions.

An example is the work being done in advanced stitching technology for composite structures.

It demonstrated that a 5-fold increase is possible in the number of composite wings manufactured per month, with an estimated 20% reduction in manufacturing costs.

In addition to those savings, composite wings allow more efficient, lighter weight designs that have lower drag, thereby reducing fuel consumption.

It is important to remember that, although each goal is presented as a distinct entity, they are interdependent.

As technologies for one goal are developed, they may contribute towards other goals as well. For example, the stitching technology I just mentioned will not only reduce the cost of air travel, it will also lead to reduced emissions.

Next, the forecast of demand for a new supersonic airliner for the long-haul market has consistently been strong. The public, rightfully, would like their time in the air to be a little shorter . . . and their at their destination to be a little longer.

Finally, if the ticket cost can be made affordable, the Pacific Rim and European markets for this aircraft could support a $200 billion industry, and 140,000 highly-skilled jobs.

Goal Six: Reduce the travel time to the Far East and Europe by 50% within 20 years and do so at today's subsonic ticket prices.

Our High-Speed Research program, built on a strong Industry-NASA partnership, continues to make substantial progress.

We are confident that the engine research to date indicates that we will overcome the emissions barrier.

One of our most recent achievements is the definition of the new Technology Concept Aircraft.

Supersonic wind tunnel tests on the concept aircraft have validated the performance predictions. We also successfully completed flight tests on an artificial vision system that would eliminate the need for a drooped nose design on future supersonic airliners.

Our current plans, which carry us out to the year 2006, have been a fruitful investment.

We are confident that this program will continue to provide solutions for overcoming the environmental and economic challenges, allowing industry to make product launch decisions on a future High Speed Civil Transport.

On the other end of the spectrum, enabling a whole new mode of personal air transportation also has tremendous social and economic importance. An estimated 20,000 smaller communities, too small to warrant scheduled commercial air services, will be better connected to the National system.

Goal Seven: Invigorate the general aviation industry, delivering 10,000 aircraft annually within years, and 20,000 within 20 years.

In the late 70s, we produced almost 20,000 general aviation planes a year. Right now we produce only 1000 general aviation planes a year.

That's not even close to where we need to be.

And although this goal is in terms of aircraft delivery, the underlying result will be to fuel a significant economic expansion beyond general aviation.

For every 10,000 new general aviation aircraft deliveries, $1 billion in sales and $2 billion in additional economic activities are projected.

It will also mean about 6,000 direct aviation jobs . . . and 24,000 associated business jobs.

Achieving this goal will also play an important role in the "travel-on-demand" needs of the growing global business world.

In addition, roughly 50% of general aviation deliveries are exported annually to areas where extensive ground transportation infrastructure does not exist.

The next goal may be the most significant because, when achieved, it will dramatically affect the way we design products from aircraft to spacecraft and much more.

Goal Eight: Provide next-generation design tools and experimental aircraft to increase design confidence, and cut the development cycle time for aircraft in half.

Imagine designing a new airplane where the design evolves 24 hours a day.

Manufacturers . . . parts designers and suppliers . . . maintenance organizations . . . and users, who are distributed in every time zone of the world . . . shape the product with their unique abilities and innovations.

This will allow designers to go beyond designing just for manufacturing, to designing for maintenance and the full life-cycle of the product.

Imagine, instead of taking the "Red Eye," these teams come and go electronically.

Imagine simulators of the individual machine.

Imagine real time assessment of inventory flow control.

Imagine simulating an entire factory -- with total immersion virtual presence, complete with sight and sound . . . perhaps even feel -- before we build it.

That's where we are going.

But even with the power of these tools, experimental aircraft will always play a significant role in validating technology.

Over the past 50 years, literally hundreds of joint flight research programs and flight experiments between NASA and DoD, most notably the X-planes, have led to significant new capabilities for operational aircraft.

We are building an unpiloted Hyper-X vehicle that will demonstrate hydrogen-fueled, airframe integrated, dual-mode ramjet and scramjet propulsion.

Flight tests at Mach 5, 7, and 10, will prove out technology that will have an immense impact in both aviation and space access.

I am committed to recapturing the pioneering spirit of the earlier days of flight testing by renewing our emphasis on X-planes. The tailless X-36 just completed flight testing and the Hyper-X will soon take to the skies at over Mach 7.

Each of these vehicles symbolizes our renewed emphasis on "innovation through flight."

And finally, the last two goals.

We need to examine what vehicle systems are the most efficient and safe for flying cargo and astronauts to and from the new Space Station and to meet our future exploration needs.

Goal Nine: Reduce the payload cost of low-Earth orbit by an order of magnitude, from $10,000 to $1,000 per pound within 10 years; and

Goal Ten: Reduce the payload cost to low-Earth orbit by an additional order of magnitude, from thousands to hundreds of dollars per pound, by the year 2020.

We are making excellent progress on our two main technology demonstration projects, the X-33 and X-34.

The X-34 has successfully completed both preliminary and critical design reviews of the vehicle's main propulsion system, and major portions of the fuselage and wing are under construction at Orbital Science's Dulles facility.

Funding for a second X-34 vehicle has also recently been approved and we anticipate the first flight of X-34 in March of next year.

During this past year, we completed the Critical Design Review of the X-33.

Specifically, we have completed over 70% of the thermal protection system design. We also conducted a successful multi-cell hot-fire test of the linear aerospike engine, and have begun flight testing it on an SR-71.

The X-33 is on track to meet it's July, 1999 launch date.

This past year we also completed the Environmental Impact Statement for the X-33 flight tests, during which we found strong and enthusiastic public support for the program.

As a result Malstrom Air Force Base, Montana was selected for the landing site for the X-33 long-range flights, and Michael Army Airfield in Utah was selected for the intermediate flights.

For the longer view, we chartered the Space Transportation Council, an internal panel, to establish the requirements for system upgrades and new space transportation systems.

The Council, after soliciting inputs from the space transportation community, has developed a comprehensive space transportation strategy and implementation plan. And they will be responsible for ensuring the plan is implemented as we attempt to make dramatic reductions in the cost of space flight.

The total picture however, is not complete. As we move forward, we must keep three things in sight:

1) The importance of measuring progress at the national level.

2) The importance of communicating with and receiving feedback from the public, and

3) The importance of international cooperation where it makes sense.

First, we must be able to track our technical progress toward the goals and communicate this information with to the public.

The public must be able to understand where their tax dollars are going.

Therefore, I am announcing a national conference on "Turning the Goals into Reality," which will be held this coming October at the Lewis Research Center in Cleveland, Ohio.

The details of this conference are still being worked out. But this will be our first opportunity to report to industry and the public at-large on our progress in achieving the Three Pillars and the Ten Goals.

Additionally, since many of these outcome goals have a global impact, we must explore the possibilities of international cooperation, and where possible, international collaboration.

Last year, I made Aviation Safety NASA's number one technology priority.

To make a meaningful impact on the safety of the entire aviation system we must think and act globally.

That is why we must take Aviation Safety from a national goal to an international goal.

We have already begun discussions with the European community to explore ways to cooperate in our safety research.

In fact, later this month we are sending a NASA and FAA delegation to Europe to define the technical details of this cooperation.

I hope we can have a future international conference with our European aviation research colleagues and others from around the world, to highlight aviation safety research because safety is everyone's business.

One last word.

The work ahead of us is hard. Sometimes it will be frustrating. It will be costly. We will have -- from time to time -- a failure.

The goals are indeed "stretch" goals.

But . . . they are by no means out of reach.

And if we continue to work together, we can take firm hold of our future . . . a future filled with hope and opportunity.

And who knows -- someday you may want to send a birthday present or care package to that grandchild you visited in California before you left for your business meeting in Tokyo.

You will go to the store . . . perhaps you will order something over the Internet.

And you will overnight the present to your grandchild's office . . .

on the International Space Station.

It's OK to dream. It's OK to set "stretch" goals. It's OK to pursue bold tasks.

It's OK . . . in fact, it's essential. Our future depends on it.

The Administration has signaled its support of NASA with the President's 1999 budget, so now we must deliver.

We at NASA have rolled up our sleeves, but, again, we can't do it alone.

We are counting on our partnerships with you . . . in industry . . . in government . . . and in academia . . . to also commit to these goals and work with us to turn them into reality.

So let's get to work. And let's get to work together.

Thank you.

NASA Administrator
Daniel S. Goldin

National Aviation Club
February 11, 1998

About a year ago,
I delivered a speech on NASA's
Three Pillars and Ten Goals . . .
our vision for Aeronautics.

Today,
I want to talk a little bit about
how we make that vision a reality --
the process and the progress.

But first,
I'd like to fuel your imagination.
I want you to think about
what a business trip of the future
might be like . . .
let's say a business trip

to Tokyo
via Los Angeles.

Your trip starts on K Street . . .
downtown,
Washington, DC.

You leave your office
and take a short walk --
maybe three minutes --
to a heliport.
There a Tiltrotor aircraft
picks you up.

It takes off --
straight up like a helicopter --
and flies directly over the terrible traffic.
The best part of the Tiltrotor . . .
especially in Washington . . .

no potholes.

15 short minutes later
you arrive at a Washington airport . . .
Dulles.

You figure
you saved at least an hour already.

You proceed to the satellite terminals.
You will be flying to Los Angeles
on your company's personal business jet.

You work for a small company,
but most companies
have their own jets now
because the cost has come down
so dramatically.
Instead of millions,
they only cost a few hundred thousand dollars . . .

maybe less.

They're also much,
much safer.

You remember the late 1990s
when a general aviation plane
had about one-tenth the reliability
of a long-haul transport jet.
Now, they're just as reliable
as the long-haul transport
of the 90s.

As you approach LAX,
you notice some fog.
No worries.

With Surface Movement Advisors
and T-NASA (Taxi Navigation And Situational Awareness),
LAX has had all-weather operations

in place for several years.
And synthetic vision
allows pilots to see through
even the heaviest of fog
(and better at night as well).

It's another advancement
that has enabled airports
to increase capacity and safety.

After arriving at LAX,
you step outside.

You notice that increased air traffic.
Capacity --
or throughput --
has at least tripled
since the 1990s.

But you can hardly hear

the airplanes.
You realize that's because
their sound is drowned out
by normal traffic.
The planes are quieter . . .
and emission have been reduced, too.

You board another Tiltrotor
for your lunch time meeting
in downtown Los Angeles.
The many traffic alerts --
and the miles of gridlock on the Freeways --
are of no concern.

This time you figure
you have saved an hour and a half of driving time . . .

three hours
of driving time if you count the trip back
to LAX . . .

and if you count
the time saved in Washington
earlier that day . . .
you figure
you have now saved over **four** hours
of driving time.

4 hours.

That's just a little less time
than your entire supersonic flight
from LA to Tokyo.
And that flight to Tokyo
doesn't cost any more
than a subsonic flight of the 1990s . . .
probably less.

In fact,
in about the same amount of time

it took you to get from your office in Washington
to downtown LA . . .

you have not only traveled from LA to Tokyo
. . . but you're also
half way through your big presentation.

And
compared to traveling in the 1990s,
it was not only faster,
but also cheaper,
better,
cleaner and safer.

All in all --
not a bad way to do business.

That's the vision.

Today,

I'd like to give a quick recap
of our goals to achieve that vision.
And I'd like to talk about where we are . . .
what we're doing . . .
and what must be done
to make sure that this a trip of the future . . .
only for the time being.

But as I do,
let the basis
for each and every goal be this:
NASA wouldn't,
couldn't and
shouldn't
do this alone.

We formulated these goals
in partnership with our industry
and FAA partners.
That was the easy part.

Our partners --

academia and industry members . . .

including aircraft manufacturers . . .

airline operators . . .

and suppliers --

must be also involved

in the hard part.

The **research and implementation**

of this vision.

NASA is focused

on the high-risk technologies

needed to achieve the stretch goals.

But we are also committed

to developing the partnerships

to transfer our work

into aerospace operations and products.

We are now

in the process of developing
national investment strategies for **each of our ten goals** .
. . something we call "Roadmaps."
These ten Roadmaps
will guide our future investments,
partnerships,
and the way we evaluate our progress.

After a very productive series
of workshops
with broad participation
from industry,
government, and academia . . .
we have completed 3 Roadmaps --
Aviation Safety . . .
airspace capacity . . .
and reducing travel times to the Far East.

This past year
we have already held

6 workshops
and have five more coming up
this spring.
And
we will have the remaining seven Roadmaps
complete by this July.

This is significant progress.

Now for the goals.
The first goal is
to improve aviation safety.

Goal One --
We want
to reduce the aircraft accident rate
by a factor of five within ten years,
and by a factor of ten within 20 years.

In support

of the President's initiative on Aviation Safety and Security,
NASA and the FAA
have formed a partnership
to accomplish
The Aviation Safety Program.

NASA
stepped up to this national priority
and has committed to reprogram $500M
of the Enterprise's budget
over 5 years.

This is not new funding,
but funding redirected
by the Enterprise
from its existing work.

I am very excited
about the progress I have seen
since March.

We worked in a very different way
to plan the Aviation Safety program.
We included partners and customers
from "day one,"
and together,
we defined the initial investment strategy,
focusing on the highest pay-off areas
for aviation safety.

In fact,
today at the National Press Club,
there will be a briefing
conducted by the Air Transport Association,
on the details of Industry's
current and future activities
for improving aviation safety.

NASA Program Plans
for Aviation Safety

will be complete late this Spring.

Our work
is split into three technical solution paths
worked out by the joint safety team:
65% is directed towards prevention,
25% towards aviation system monitoring
and modeling,
and 10% towards accident mitigation.

In terms of technology,
together,
we must come up with the technologies
for advanced crew interface.
We must give pilots situational awareness
of their surroundings.
That means real-time weather . . .
terrain. . .
and on board air traffic control.

Pilots must have not just data,
but knowledge . . .
so they can immediately take the right course of action.

We are also working
on creating smart airplanes . . .
that can predict,
detect,
and correct
potential malfunctions
before they become serious problems.

Already,
in 1997
we successfully demonstrated cockpit systems
for enhanced situational awareness
during landing
and aircraft rollout and taxiing
at Atlanta Hartsfield Airport.

These systems aid pilots
in viewing the runway and taxiways
during night or adverse weather,
improving airport safety
and increasing capacity.

The next area
is environment.

We need to make sure
that environmental issues
do not constrain air transportation growth.

Aircraft emissions are an issue
with local air quality
and global impact . . .
and aircraft noise
is an issue prompting
an ever increasing number of airports,
both here and abroad,

to restrict airline operations.

So we've developed the following goals:

Goal Two --
We want to reduce emissions
of future aircraft
by a factor of three within 10 years,
and by a factor of five within 20 years.

And Goal Three --
We want to reduce the perceived noise levels
of future aircraft
by a factor of two
from today's subsonic aircraft within 10 years,
and by a factor of four within 20 years.

Last May,
we published the first scientific assessment
of aviation's global atmospheric impacts.

These results
and the continuing scientific research
will greatly help the aviation community
respond to the Kyoto Protocol
for reducing greenhouse gas emissions.

We also made excellent progress
in combustion technology
with laboratory demonstrations of a 70% reduction
in nitrogen oxides
below current ICAO standards
for local air quality.

This is moving well towards our objectives
at the ten-year horizon.
However,
there is still much to be done
to prove effective and economic emission control
on production-scale hardware.

As for reducing the noise levels . . .
research advancements in jet noise,
fan noise,
and nacelle duct treatments
show a 4 decibel reduction
in community noise impact.

This is tremendous progress.

In airport terms,
an airplane's noise "footprint"
is reduced almost 33% . . .
from an 8 square mile baseline
to less than 5 and a half square miles.

The year 2000 goal
is to provide technology
that could reduce the noise footprint
to two and a half square miles,

for a 68% reduction.

Being globally competitive
will require non-traditional collaborations
and a willingness
to trust this strategic outlook.
We are looking at the longer term,
approaching these areas with some restraint
because we realize
he environmental challenges are complex
and sensitive issues.

Let me add that
these goals
must not
be construed as a "done deal,"
especially
for regulatory purposes

It will be chilling to the program

if regulators assume our stretch goals
can be used for establishing premature
or inappropriate regulations.

that NASA is not in the business
of encouraging regulatory limits.
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we must keep three things in sight:

1) The importance of measuring progress
at the national level.

2) The importance of communicating with
and receiving feedback from
the public,
and

3) The importance of international cooperation
where it makes sense.

We must be able to track
our technical progress toward the goals
and communicate this information
with the public.

And the public
must be able to understand
where their tax dollars are going.

Therefore,
I am announcing a national conference

on "Turning the Goals into Reality,"
which will be held
this coming October
in Cleveland, Ohio.

The details of this conference
are still being worked out.
But this will be our first opportunity
to report to industry
and the public at-large
on our progress in achieving
the Three Pillars and the Ten Goals.

Additionally,
since many of these outcome goals
have a global impact,
we must explore
the possibilities of international cooperation,
and where possible,
international collaboration.

Last year,
I made Aviation Safety
NASA's number one technology priority.

To make a meaningful impact
on the safety of the entire aviation system
we must think and act globally.

That is why,
I believe,
we must take Aviation Safety
from a national goal
to an international goal.

We have already begun discussions
with the European community
to explore ways to cooperate
in our safety research.

And later this month,
we are sending a NASA and FAA delegation
to Europe
to define the technical details
of this cooperation.

I hope
we can have a future international conference
with our European aviation research colleagues
and others from around the world,
to highlight aviation safety research . . .
because safety
is <u>everyone's</u> business.

One last word.

The work ahead of us
is hard.
Sometimes it will be frustrating.
It will be costly.

We will have --
from time to time --
a failure.

The goals are indeed
"stretch" goals.

But . . .
they are by no means
out of reach.

And if we continue to work together,
we can take firm hold of our future . . .
a future filled with hope and opportunity.

And who knows --
on that trip of the future to Tokyo,
you may pick up a gift
for your grandchild.

And you will be able
to send that gift --
affordably and reliably --
to your grandchild's office . . .

on the International Space Station.

It's OK to dream.
It's OK to set "stretch" goals.
It's OK to pursue bold tasks.

It's OK . . .
in fact,
it's essential.

Our future depends on it.

The Administration
has signaled its support of NASA
with the President's 1999 budget,

so now we must deliver.

We at NASA
have rolled up our sleeves,
but, again,
we can't do it alone.

We are counting on our partnerships
with you . . .
in industry . . .
in government . . .
and in academia . . .
to work with us
to turn these goals into reality.

So let's get to work.
And let's get to work together.

Thank you.